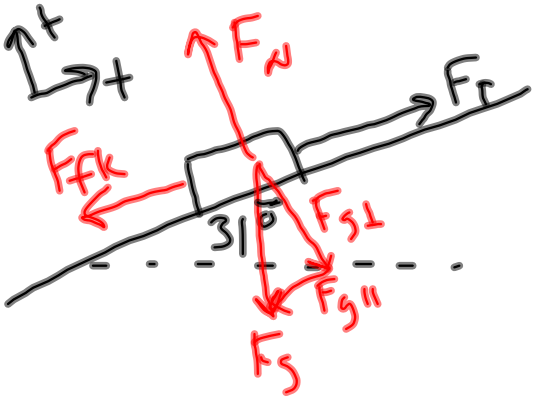
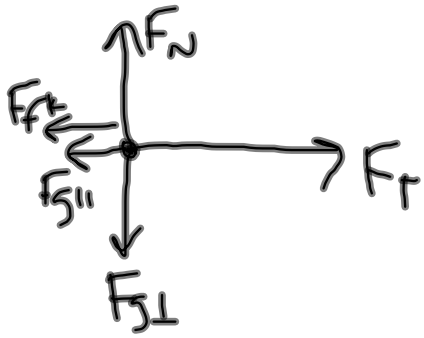
A 300 kg log is pulled up a ramp by means of a rope that is parallel to the surface of the ramp. The ramp is inclined at 31 degrees with respect to the horizontal. The coefficient of kinetic friction between the log and ramp is 0.90, and the log has an acceleration of 0.90 m/s/s. Find the tension in the rope.





$$\Sigma \vec{F}_{\parallel} = m a_{\parallel}$$

$$F_T - F_{g\parallel} - F_{fk} = m a_{\parallel}$$

$$F_T = F_{g\parallel} + F_{fk} + m a_{\parallel}$$

$$= mg\sin(31°) + mg\cos(31°)\mu_k + m a_{\parallel}$$

$$= 4052\ N$$

$$\Sigma \vec{F}_{\perp} = 0$$

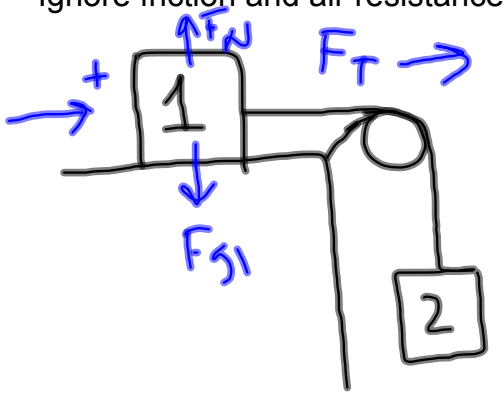
$$F_N - F_{g\perp} = 0$$

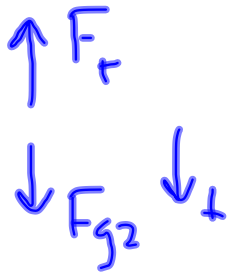
$$F_N = F_{g\perp}$$

$$= mg\cos(31°)$$

$$F_{fk} = \mu_k F_N$$

Two blocks are connected over a massless pulley by a rope. The first block is on a table and weighs 426 N, and the second is hanging off the table and weights 195 N. Ignore friction and air resistance, and find the acceleration of the two blocks.





$$\Sigma \vec{F}_2 = m_2 \vec{a}$$

$$-F_T + F_{g2} = m_2 a$$

$$-m_1 a + F_{g2} = m_2 a$$

$$\Sigma \vec{F}_1 = m_1 \vec{a}$$

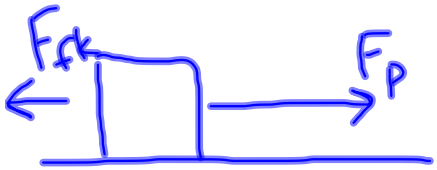
$$F_T = m_1 \vec{a}$$

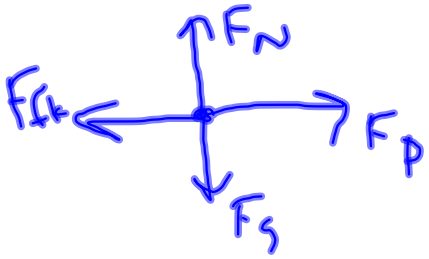
$$a = \frac{F_{g2}}{m_1 + m_2}$$

$$= 3.08 \text{ m/s}^2$$

Quarter 1 Exam Practice Problems 10.13.11 AP Physics

A 6.0 kg block initially at a velocity of 1.5 m/s is pulled to the right along a horizontal surface by a constant horizontal force of 12 N.
a) Find the speed of the block after it has moved 3.0 m if the surfaces in contact have a coefficient of kinetic friction of 0.12.
b) Find time it takes for the block to move using the impulse-momentum theorem.





$F_{fk} = \mu_k F_N$

$= \mu_k mg$

$= 7.06\ N$

a) $W = \Delta K = K_f - K_i = \frac{1}{2}m(v_f^2 - v_i^2)$

$\Sigma F d \cancel{\cos\theta}^{1} = \frac{1}{2}m(v_f^2 - v_i^2)$

$(F_p - F_{fk})d = \frac{1}{2}m(v_f^2 - v_i^2)$

$v_f = 2.68\ m/s$

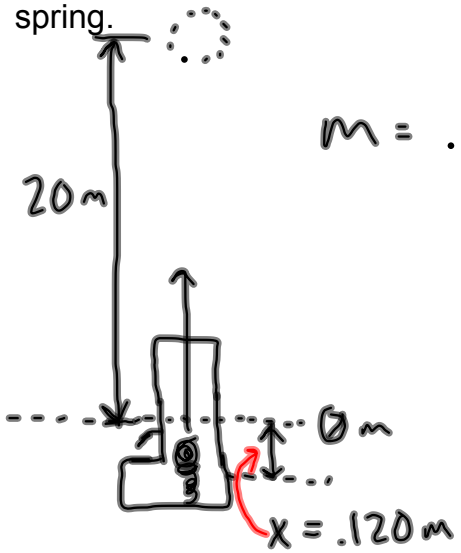
b) $\Sigma \bar{F} \Delta t = m \Delta \bar{v}$

$\Delta t = \frac{m\Delta \bar{v}}{\Sigma \bar{F}}$

$= 1.43\ s$

Quarter 1 Exam Practice Problems 10.13.11 AP Physics

The launching mechanism of a popgun consists of a spring of unknown spring constant. When the spring is compressed 0.120 m, the gun, when fired vertically, is able to launch a 35.0 g projectile to a maximum height of 20.0 m above the position of the projectile as it leaves the spring.
a) Neglecting all resistive forces, determine the spring constant.
b) Find the speed of the projectile as it moves through the equilibrium position of the spring.



$m = .035\ kg$

a) $K_i^{\,0} + U_{gi} + U_{si} = K_f^{\,0} + U_{gf} + U_{sf}^{\,0}$

$mgh_i + \frac{1}{2}kx^2 = mgh_f$

$k = \frac{2mg(h_f - h_i)}{x^2}$

$= 958\ N/m$

b) $K_i^{\,0} + U_{gi} + U_{si} = K_f + U_{gf}^{\,0} + U_{sf}^{\,0}$

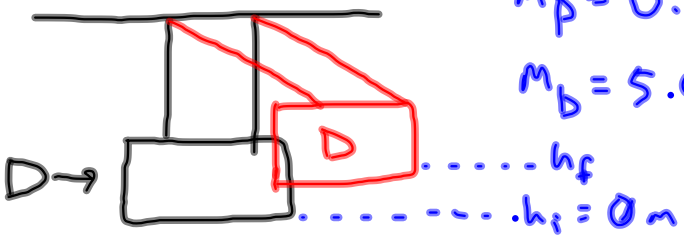
$mgh_i + \frac{1}{2}kx^2 = \frac{1}{2}mv_f^2$

$v_f = \sqrt{\frac{2(mgh_i + \frac{1}{2}kx^2)}{m}}$

$= 19.9\ m/s$

Quarter 1 Exam Practice Problems 10.13.11 AP Physics

The ballistic pendulum is an apparatus used to measure the speed of a fast-moving projectiles such as a bullet. A projectile of mass 0.055 kg is fired into a large block of wood with mass 5.00 kg suspended from some light wires. The projectile embeds in the block, and the entire system swings up to a height of 35 cm. What is the speed of the projectile just before it hits the block?



$m_p = 0.055$ kg $\quad h_f = .35$ m

$m_b = 5.00$ kg

$$m_p v_{pi} + m_b v_{bi} = (m_p + m_b) v_f$$

$$v_{pi} = \frac{(m_p + m_b) v_f}{m_p} = 241 \text{ m/s}$$

$$K_i + U_{gi} = K_f + U_{gf}$$

$$m_c = m_p + m_b \quad \frac{1}{2} m_c v_i^2 = m_c g h_f$$

$$v_i = \sqrt{\frac{2 m_c g h_f}{m_c}} = \sqrt{2 g h_f}$$

$= 2.62$ m/s $\Rightarrow$ final velocity in inelastic collision